Each wafer W is mounted upon and clamped to a wafer support pad 102 via one or more conventional clamps 104 such as a mechanical or electrostatic clamp or other means known to those skilled in the art. The wafer support pad 102 comprises a circular plate which has a substantially flat upper surface 104 for mounting a wafer W thereon. Mounted to the undersurface of the wafer support pad 102 is one or more cooling passages 103 (hereinafter referred to as "cooling passage") for circulating coolant in order to cool the wafer. The cooling passage shall be dip brazed, bolted or held together by any conventional means. The cooling passage 103 preferably has a circular cross section and is comprised of a material having a high thermal conductivity such as aluminum. It is even more preferable that the interior surfaces of the cooling passages be coated with an anti-wear coating such as polytetrafluroethylene (PTFE) or any other form of hardcoat that prevents degradation of the pad base material.

As shown in Figures 3 and 5, the cooling passage 103 has an inlet end 106 and a outlet end 108 located near the centerpoint of the wafer support pad 102. More specifically, the geometric centers of the inlet end 106 and the outlet end 108 are spaced in an opposed configuration equi-distant from the geometric center of the wafer W. The coolant passage is arranged in a serpentine fashion that is symmetrical about an axis of the wafer support pad 102. As shown in Figure 3 for illustrative purposes, the coolant passage is denoted as two sections "103a" and "103b", wherein 103a is representative of the inlet section of the coolant passage, and 103b is representative of the outlet section of the coolant passage. As further shown in Figure 3, section 103a and 103b are symmetrical about an axis, in particular, the x axis. This symmetrical relationship results in the coolant mass of the inlet section of the coolant passage 103a being counterbalanced by the coolant mass of the outlet section of the coolant passage, denoted as 103b. The end 110 of the inlet cooling passage 103a feeds into the inlet end 112 of the outlet cooling passage. The inlet coolant section 103a and the outlet coolant section 103b may also be arranged in numerous other configurations (not shown) such that the coolant mass of the inlet section is counterbalanced by the coolant mass of the outlet section.

The coolant provided in the inlet and outlet cooling passages may be any suitable cooling fluid such as water, antifreeze, freon or mixtures thereof, or any other suitable coolant known to those skilled in the art.

The lower surface of the wafer support pad 102 is secured to a FIXED cover plate 130. The cover plate 130 is also a flat circular plate and is made of Aluminum material,

and functions to enclose the cooling passages and mount the assembly to the radius frame. The cover further comprises an inlet feed hole 132 and an outlet return hole 134 for receiving there through the ends 106,108 of the respective inlet and outlet cooling fluid passages. As best shown in Figure 2, the wafer pad assembly 100 further includes a wafer pad radius frame 200 which is mounted to the under surface of the cover plate 106. The radius frame 200 comprises an outer wear surface 202 having an exterior curved surface to allow rotation or "tilt motion" of the wafer pad assembly about the z axis which is also the geometric centerline of the top of the mounted wafer. The outer wear surface 202 has an outer convex surface and is aligned for slidable engagement with a complementary shaped bearing surface 302 of cam housing 300. As the outer wear surface 202 slidably engages the bearing surface 302, the wafer is preferably rotated about its geometrical center. The radius shape of the outer wear surface allows rotation of the wafer from 0 to 45 degrees . The outer wear surface 202 is formed of a material having a low coefficient of friction such as hard chrome or nickel plated steel or aluminum.

As shown in Figure 4, the radius frame 200 has a rectangular cross section with opposed sidewalls 201. Mounted within the sidewalls 201 are one or more curved cam follower raceways 204. Preferably, two opposed raceways 204 are utilized. The cam follower raceways 204 have the same curvature as the outer wear surface 202. Received within each of the raceways 204 are one or more cam followers 205, which function to secure the semi-hemispherical frame 200 to the cam housing 300 while allowing the outer wear surface of the frame 200 to slidably engage the cam bearing surface so that the wafer can tilt. The cam followers 205 further function to carry the centrifugal load of the spinning disk 40 as well as to maintain the seal gap located between the rotating inlet and outlet ends 106,108 of the coolant passage 103 and the fixed passagways 206,208, as described in more detail below.

The cam housing 300 has a generally rectangular shape with opposed parallel sidewalls 304, the cam bearing surface 302, and an internal cavity 306. Preferably one of the sidewalls 304 is formed from a removable plate 310 for accessing the interior portion of the cavity. Sidewalls 304 preferably have truncated interior corners 305 so that the semi-hemispherical frame 200 can rotate without interference.

Contained within the internal cavity 306 are return and feed coolant lines 206,208 which are connected to and along the curved underside of the cam bearing surface 302.

The feed and return coolant lines 206, 208 further comprise slots 210 aligned with passageways 310 of the curved bearing surface 302. The slots 210 of the feed and return coolant lines 206, 208 are in fluid communication with the respective ends 106, 108 of the coolant passage 103. It is important to note that the ends 106, 108 of the coolant passage 103 rotate or tilt with the semi-hemispherical frame 200 and maintain fluid communication with the non-rotating return and feed coolant lines 206, 208 during rotation. In addition, as the semi-hemispherical frame 200 rotates, the outer wear surface 202 of the frame functions as a seal to prevent coolant from escaping from passageways 310 of the curved bearing surface 302. Preferably, one or more grooves 314 surround the periphery of the passageways 310 of the cam bearing surface 302 wherein one or more seals 320, preferably o-ring, are provided therein to prevent coolant from escaping from the internal cavity. An optional second set of grooves and seals may be used as a "telltale" i.e., to indicate coolant leakage from the cam housing.

The wafer pedestal assembly further comprises a flange 400 for connecting to an actuator. The actuator may be comprised of linkages, cables, electric actuators or any means to convey the motion to the movable portion of the wafer pad.

Figure 7 illustrates the side perspective view of an ion implanter disk having two or more wafer pedestals of the invention mounted thereon. The wafer pedestal assemblies 100 are shown tilted at a 45 degree orientation. A coolant distribution hub 500 is shown located near the center portion of the disk 40 with coolant manifold system lines extending radially outward in fluid communication with the return and feed lines 206, 208 of the pedestal assembly.

While the wafer cooling system has been shown and described in conjunction with an assembly for tilting wafers, the above referenced cooling system is not limited to such application. For example, the wafer cooling system could also be used in conventional batch or serial ion implanters. Further, while the wafer pedestal tilting mechanism is shown primarily for use in a batch type ion implanter, the invention could also be used in conjunction with serial ion implanters. Finally, the wafer pedestal tilting mechanism could also be used with other cooling systems.

INVENTORS: HOW WOULD YOU MODIFY THE INVENTION FOR USE IN A SERIAL IMPLANTER? See drawing sent by Weed

While the invention has been shown and described with respect to specific embodiments thereof, this is for the purpose of illustration rather than limitation, and